CLAIMS

What is claimed is:

1.   A control system for controlling the shielding gas supply of an automatic welding apparatus, which automatic welding apparatus has a continuous electrode feed device having a feed signal output which is indicative of a continuous electrode feeding speed (U), which automatic welding apparatus is connected to a gas tank via a gas supply line, in which supply line there may according to choice be arranged a pressure regulator and a manometer, characterised in that the control system comprises

a controllable gas flow valve having a valve gas inlet, a valve gas outlet and a valve control signal input for receiving a valve control signal;

a gas flow sensor having a gas inlet, a gas outlet and a sensor signal output; and

a programmable control circuit having a first and a second input and a first output; wherein the gas tank has an inlet connection to the valve gas inlet, the valve gas outlet has a valve outlet connection to the gas inlet, the gas outlet has a gas outlet connection to a shielding gas outlet, the feed signal output has a feed signal connection to the first input, the sensor signal output has a sensor signal connection to the second input, the first output has a control signal connection to the valve control signal input,

the programmable control circuit comprises a processor which, in accordance with at least one program in a first memory in the control circuit, and on the basis of signals received at the first and second inputs, provides at the first output the valve control signal, which provided valve control signal is adjustable by means of the programmable control circuit within a dynamic range of values limited in accordance with a predetermined minimum gas flow (Qmin) through the valve and a predetermined maximum gas flow (Qmax) through the valve, and

the program comprises at least one instruction to the processor instructing the processor to issue at the first output a signal that is constant and having a value which corresponds substantially to the minimum gas flow (Qmin) through

the valve from the time the signal at the first input exceeds a first threshold value (Uth1) and in an immediately subsequent first predetermined time period.

2.   A control system for controlling the shielding gas supply of an automatic welding apparatus, which automatic welding apparatus has a continuous electrode feed device having a feed signal output which is indicative of a continuous electrode feeding speed (U), which automatic welding apparatus is connected to a gas tank via a gas supply line, in which supply line there may according to choice be arranged a pressure regulator and a manometer,

characterised in that the control system comprises

a controllable gas flow valve having a valve gas inlet, a valve gas outlet and a valve control signal input for receiving a valve control signal;

a gas flow sensor having a gas inlet, a gas outlet and a sensor signal output; and

a programmable control circuit having a first and a second input and a first output; wherein the gas tank has an inlet connection to the valve gas inlet, the valve gas outlet has a valve outlet connection to the gas inlet, the gas outlet has a gas outlet connection to a shielding gas outlet, the feed signal output has a feed signal connection to the first input, the sensor signal output has a sensor signal connection to the second input, the first output has a control signal connection to the valve control signal input,

the programmable control circuit comprises a processor which, in accordance with at least one program in a first memory in the control circuit, and on the basis of signals received at the first and second inputs, provides at the first output the valve control signal, which provided valve control signal is adjustable by means of the programmable control circuit within a dynamic range of values limited in accordance with a predetermined minimum gas flow (Qmin) through the valve and a predetermined maximum gas flow (Qmax) through the valve, and

the control circuit comprises a second memory arranged to continuously register the signal value at the first output of the control circuit; and

that the program comprises at least one instruction to the processor instructing the processor issue at the first output from the time the signal at the first input falls short of a second threshold value (Uth2) and in an immediately subsequent second predetermined time period signal that us constant and having a value that substantially corresponds to the signal value at the time, or immediately prior to the time, when the signal at the first input fell short of the second threshold value.

3.   The control system of claim 1, characterised in that the programmable control circuit has a third input, said third input is a communications port for the transfer of the at least one program from a programming device, via a communication connection, to the memory.

4.   The control system of claim 1, characterised in that the program comprises at least one instruction to the processor instructing the processor to issue the valve control signal as a signal that is proportional to a signal representing the difference between the signal at the first input and the signal at the second input.

5.   The control system of claim 1, characterised in that the program comprises at least one instruction to the processor instructing the processor to issue the valve control signal as a signal that is proportional to a signal representing the difference between the signal at the first input and the signal at the second input, proportional to a signal representing a time integral of the difference between the signal at the first input and the signal at the second input, and proportional to a signal representing a time derivative of the difference between the signal at the first input and the signal at the second input.

6.   The control system of claim 3, characterised in that the first threshold value (Uth1) is equal to a second threshold value (Uth2).

7.   The control system of claim 2, characterised in that the control circuit comprises a control parameter register for storing at least one of the minimum gas flow (Qmin) through the valve, the maximum gas flow (Qmax) through the valve, a first threshold value (Uth1), the second threshold value (Uth2), a continuous electrode feeding speed minimum threshold (Umin) and a continuous electrode feeding speed maximum threshold (Umax),

that the program comprises at least one instruction to the processor instructing the processor to set a proportionality so that the control circuit at the first output issues the valve control signal in accordance with minimum value (Qmin) when the feeding speed (U) corresponds to the feeding speed minimum threshold (Umin) and in accordance with the maximum value (Qmax) when the feeding speed (U) corresponds to the feeding speed maximum threshold (Umax); and

that the program comprises at least one instruction to the processor instructing the processor to issue at the first output the valve control signal in accordance with the minimum gas flow (Qmin) through the valve when the continuous electrode feeding speed (U) is below the feeding speed minimum threshold (Umin) and the valve control signal in accordance with the maximum gas flow (Qmax) through the valve when the feeding speed (U) is above the feeding speed maximum threshold (Umax).

8.   The control system of claim 7, characterised in that the programmable control circuit has a second output that issues a warning signal when the first output issues the valve control signal in accordance with the minimum gas flow (Qmin) through the valve or when the feeding speed (U) is equal to or lower than the feeding speed minimum threshold (Umin).

9.   The control system of claim 7, characterised in that the programmable control circuit has a second output that issues a warning signal when the first output issues the valve control signal in accordance with the maximum gas flow (Qmax) through the valve or when the feeding speed (U) is equal to or higher than the feeding speed maximum threshold (Umax).

10. The control system of claim 3, characterised in that the communications port is also arranged for the transfer of control parameters from the programming device, via the communication connection, to the programmable control circuit.

11. The control system of claim 3, characterised in that the communications port is also arranged for the transfer between the programming device and the programmable control circuit of data stored in, or for storage in, the parameter register and of data representing at least one of a valve control signal, a feeding speed (U), and a warning signal.

12. The control system of claim 3, characterised in that the programming device comprises a user interface for the input of control parameters and for the display of data transferred to and from the programmable control circuit.

13. The control system of claim 3, characterised in that the programming device is a personal computer (PC).

14. A method for controlling a shielding gas supply in an automatic welding apparatus by means of the control system of claim 1 , the method characterised by

outputting the valve control signal at the first output in the form of a signal that is proportional to a signal representing a difference between the signal at the first input and the signal at the second input, and outputting at the first output the valve control signal as a signal that is constant and having a value which corresponds substantially to the minimum gas flow (Qmin) through the valve from the time the signal at the first input exceeds a first threshold value (Uth1) and in an immediately subsequent first predetermined time period.

15.   A method for controlling a shielding gas supply in an automatic welding apparatus by means of the control system of claim 1, the method characterised by

outputting the valve control signal at the first output in the form of a signal that is proportional to a signal representing the difference between the signal at the first input and the signal at the second input, and

outputting at the first output, from the time that the signal at the first input fall short of a second threshold value (Uth2) and in an immediately subsequent second predetermined time period, the valve control signal as a signal that is constant and having a value that substantially corresponds to the signal value at the time, or immediately prior to the time, when the signal at the first input fell short of the second threshold value.

16.   A method for controlling a shielding gas supply in an automatic welding apparatus by means of the control system of claim 1, the method characterised by

outputting the valve control signal at the first output in the form of a signal that is proportional to a signal representing the difference between the signal at the first input and the signal at the second input, proportional to a signal representing a time integral of the difference between the signal at the first input and the signal at the second input, and proportional to a signal representing a time derivative of the difference between the signal at the first input and the signal at the second input, and

outputting at the first output the valve control signal as a signal that is constant and having a value which corresponds substantially to the minimum gas flow (Qmin) through the valve from the time that the signal at the first input exceeds a first threshold value (Uth1) and in an immediately subsequent first predetermined time period.

17.   A method for controlling a shielding gas supply in an automatic welding apparatus by means of the control system of claim 1, the method characterised by

outputting the valve control signal at the first output in the form of a signal that is proportional to a signal representing the difference between the signal et the first input and the signal at the second input, proportional to a signal representing a time integral of the difference between the signal at the first input and the signal at the second input, and proportional to a signal representing a time derivative of the difference between the signal at the first input and the signal at the second input, and

outputting at the first output, from the time that the signal at the first input falls short of a second threshold value (Uth2) and in a immediately subsequent second predetermined time period, the valve control signal as a signal that is constant and having a value that substantially corresponds to the signal value at the time, or immediately prior to the time, when the signal at the first input fell short of the second threshold value.

18.   The method of claim 15, characterised in that the first threshold value (Uth1) is equal to the second threshold value (Uth2).

19.   The method claim 15, characterised by storing in a control parameter register in the control circuit at least one of the minimum gas flow (Qmin) through the valve, the maximum gas flow (Qmax) through the valve, the first threshold value (Uth1), the second threshold value (Uth2), a continuous electrode feeding speed minimum threshold (Umin) and a continuous electrode feeding speed maximum threshold (Umax);

setting a proportionality so that the control circuit at the first output issues the valve control signal in accordance with minimum gas flow (Qmin) through the valve when the continuous electrode feeding speed (U) corresponds to the wire feeding speed minimum threshold (Umin) and the maximum gas flow (Qmax) through the valve when the wire feeding speed (U) corresponds to the wire feeding speed maximum threshold (Umax); and

by issuing at the first output the valve control signal in accordance with the minimum gas flow (Qmin) through the valve when the wire feeding speed (U) is below the feeding speed minimum threshold (Umin) and the maximum gas

flow (Qmax) through the valve when the feeding speed (U) is above the feeding speed maximum threshold (Umax).

20. The method of claim 15, characterised by issuing at a second output of the programmable control circuit a warning signal when the first output issues the valve control signal in accordance with the minimum gas flow (Qmin) through the valve or when the feeding speed (U) is equal to or lower than the feeding speed minimum threshold (Umin), or a warning signal when the first output issues the valve control signal in accordance with the maximum gas flow (Qmax) through the valve or when the feeding speed (U) is equal to or higher than the wire feeding speed maximum threshold (Umax).

21. The method of claim 15, characterised by transferring control parameters, from a programming device, via a communication connection, to the programmable control circuit.

22. The method, of claim 15 characterised by transferring between a programming device and the programmable control circuit, via a communication connection, data stored, or for storage in the parameter register, and data representing at least one of a valve control signal, a feeding speed (U), and a warning signal.

23. The method of claim 22, characterised by entering control parameters and by displaying data transferred to and from the programmable control circuit, by means of a user interface in the programming device.

24. The method of claim 22, characterised in that the programming device is a personal computer (PC).

25. A welding apparatus, characterised in that it comprises the control system of claim 1.